

REMARKS

Regarding the Examiner Interview of 23.Jan.2001:

The undersigned thanks Exr. Tuyen Nguyen, and Exr. Lincoln Donovan for their courtesy and helpful discussion during the in-person interview at the USPTO.

Regarding the rejection of claims 1-5, 7-9, 14 and 19 under 35 USC 103(a) in view of US 3538474 to Olsen in view of US 5063654 to Klappert:

The applicants respectfully traverse the rejection of the claims in view of the U.S. patents to Olsen and Klappert.

A key technical advantage provided only by the present invention lies in the fact that the present inventors have provided a transformer core, transformer core segments, as well as a method for their manufacture which overcomes many of the known technical prejudices in the art. A key factor which distinguishes the present invention from many of the prior art documents cited by the Office is in the nature of the annealed amorphous metal itself. It is known in the art that annealed amorphous metal is particularly difficult to handle on several counts. First, it is substantially thinner than grain oriented silicon steel which is commonly used in transformer cores. This thinness complicates any manufacturing process which contemplates the use of amorphous metals in transformer cores. First, it requires a much greater number of lamination layers in order to "build up" a sufficient thickness of the amorphous metal in the transformer core. Second, this concomitantly complicates any process wherein such amorphous metal strips are handled. Simply speaking the greater number of layers necessarily require more manufacturing steps in order to build up a comparably sized transformer core having the same thickness as one produced from grain oriented silicon steel. A third, and perhaps most significant distinction, lies in the handling limitations inherent to annealed amorphous metals themselves. It is recognized in the art that annealed amorphous metals are very brittle and require very careful handling. For example, in U.S. Patent No. 5,134,771 to Lee et al., at column 6, lines 17-20, this limitation is recognized. (Incidentally, the amorphous metal strip used in U.S. Patent No. 5,134,771 is an amorphous iron alloy purchased from AlliedSignal Corporation,

METGLAS transformer core (TCA); the present assignee, Honeywell is successor-in-interest to AlliedSignal Corporation.) Also, at column 1, lines 40 et seq., Lee notes that "... this approach is limited utility in the manufacture of amorphous metal cores because the amorphous steel strip material from which the core is formed is very brittle, especially after annealing, and is highly susceptible at this time to being cracked or shattered by any vigorous impacts delivered to the core". This shortcoming in the nature of annealed amorphous metals was demonstrated in the Examiner interview of 23 January 2001. Therein, sample sheets of grain-oriented silicon steel, on annealed amorphous metal, and annealed amorphous metals were demonstrated and compared. During even the simplest handling, the extremely brittle of the annealed amorphous metals were demonstrated as very easily prone to shattering or breakage. These characteristics were in sharp contrast to the more flexible and deformable grain-oriented silicon steel, and to a lesser extent, the unannealed amorphous metals.

With these technical limitations in mind, it is fair to say that there exists in the art a significant technical prejudice against the use of amorphous metals which require annealing in transformer cores. As discussed previously, as well as acknowledged by Lee et al. (above), it is contemplated that any handling operation such as may be required during the relacing of a joint provides a very high risk of breakage of an amorphous metal. This shortcoming dissuades the more wide-spread use of annealed amorphous metals in transformer cores, as well as dissuades the use of prior art techniques for their manufacture.

A further very relevant technical consideration which is generally not required of grain-oriented silicon steel lies in the fact that after winding to form a transformer core, an amorphous metal transformer core usually requires annealing in the presence of a magnetic field in an appropriate oven. This annealing step is well-known to the art and indeed it is during this annealing operation that the assembled amorphous metal core becomes embrittled, while at the same time, internal stresses are reduced. Great care must be taken in this annealing operation in that a sufficiently high reduction in the internal stress need be accomplished yet at the same time there is a risk of increased embrittlement due to excessive residence times at elevated temperatures in an annealing oven. Naturally, these two competing needs need be balanced and frequently, due to the consideration that such transformer cores are ideally optimized to provide the best performance characteristics, longer rather than shorter annealing are practiced which

also introduces greater degrees of embrittlement. As noted, the annealing operation also generally requires that the annealing take place in the presence of a magnetic field which need be excited within the annealing transformer core. Typically, this is achieved by wrapping a cable about the assembled transformer core during the annealing process, and passing a current therethrough. The current passing through the windings energizes the transformer coil and such is known to beneficially improve the operating characteristics of the transformer core. Again, however, such a step typically contemplates that it is necessary that the transformer core be fully assembled during the annealing operation in order to excite an appropriate magnetic field therein. This, in turn, necessary requires that, subsequent to the annealing operation and after the transformer has cooled, that the now-annealed amorphous metal transformer core be unlaced at a joint thereof, and then relaced after suitable transformer coils have been placed upon one or more legs of the amorphous metal transformer core. This operation necessarily requires a minimum of two handling steps, and "unlacing" step and a subsequent "relacing" step in order to reconstitute the annealed amorphous transformer core. Such handling is well known to involve risks of breakage and flaking, particularly in the joint region as the annealed metal needs to be flexed and deformed from its assembled configuration during the annealing process. Again, the brittleness of this material, as mentioned in U.S. Patent No. 5,134,771 to Lee is known to be highly problematic. However, transformer cores of grain-oriented silicon steel need not be annealed.

From this understanding of limitations of annealed amorphous metal transformer cores, it is fair to say that one of relevant skill in the art in the manufacture of transformer cores of amorphous metals would also be prone to avoid any transformer core construction which included multiple joints. It would be clear to foresee that the manufacture of any transformer core of an annealed amorphous metal having multiple joints might introduce undesired core losses due to magnetic losses in the regions of the joints. Further, any transformer core having multiple joints forming an annealed amorphous metal would also likely be considered highly problematic to assemble. The presence of multiple joints would be expected to require multiple handling operations at each one of the joints and such would further be expected to increase the likelihood of undesired losses in the region of each of these joints.

Still further, it has to the present time been thought in the art that the during the annealing step an amorphous metal transformer core need be wholly constituted in its final form in order to

ensure the maximum efficacy of the magnetic flux passing through it due to the presence of the exciting field provided by the windings discussed previously. Such would be expected to also detract from any reasonable consideration of multi-jointed transformer cores as it was believed that a uniform magnetic field need be present throughout the assembled transformer core during the annealing step in order to ensure that the ultimately produced transformer core would operate at its best operating efficiency.

Surprisingly, the present inventors have discovered that many of these prior preconceptions and technical prejudices can be overcome by the transformer cores, transformer core segments, and methods of their manufacture as described in the applicants' specification. Such surprising discoveries also, considered in light of these known technical prejudices intended upon the use of annealed amorphous metal transformer cores, cannot fairly be said to be considered obvious from the prior art of record.

Turning now to the Olsen reference, the Olsen reference is useful in demonstrating certain core joint lap constructions which, however, are limited to conventional silicon steel type transformer cores. Olsen describes in his patent at column 2, lines 51-52, that "core 10 comprises two C-shaped sections 11 and 13, each comprising individual laminations of grain-oriented magnetic material". The skilled practitioners in the relevant art would immediately understand from this passage that Olsen's vintage 1968 transformer core would be made of conventional grain-oriented silicon steel. As noted above, such silicon steel material has substantially different handling characteristics which are vastly differentiable from amorphous metals. Indeed, it appears that the sole technical advantage provided by Olsen lies in the fact that according to this fabricating process, his transformer cores produce the assembly time necessary by having a series of offset laminations within his cores which provide a "relatively long-guiding surface which readily permits smooth alignment of the two core sections 31 and 33 in final assembly of the core". U.S. Patent No. 3,538,474, column 4, lines 11-13. It is not insignificant to also note that it seems quite apparent from Olsen's specification and particularly his figures that apparently his cores are constituted by pushing together two C-shaped segments. This is further supported by his statement wherein he notes that "I spray a smooth adhesive coating of relatively low friction material over the ends of the laminations on one or both of sections 11 and 13 in order to facilitate a slipping together of the two sections when they are brought together to

form a joint 15". U.S. Patent No. 3,538,474, column 3, lines 38-42. Understanding the entire teaching of Olsen then, it appears to be limited to an improved arrangement of joints in silicon steel oriented cores in a method by which such joints can be made.

Certain inherent limitations are also present in the Olsen reference which would not be overlooked by one of appropriate skill in the art. First and foremost, Olsen's construction is limited to grain-oriented magnetic materials, and most commonly such a grain-oriented magnetic material would be expected to be a silicon steel which is most widely used in the transformer industry. As noted above, such materials are flexible, and relatively thick compared to the general thickness of amorphous metal sheets. A second limitation inherent in the Olsen transformer construction lies in the fact that such transformer cores generally need not be annealed. Due to the thickness of the silicon steel strips, coupled with the fact that lesser laminar layers are required to "build up" a transformer core of sufficient thickness, the skilled practitioner in the art reading Olsen's reference would not understanding there to be any need for annealing any part of his transformer cores. This is not to be over looked. As discussed previously, the annealing operation, as currently widely practiced with reference to amorphous metal cores requires that the amorphous metal core be fully constituted, and then annealed in the presence of an appropriate magnetic field. Subsequent to cooling, the core would need to be unlaced in order to permit the insertion of transformer coils about one or more legs of the annealed amorphous metal transformer core. Such an unlacing operation provides a real risk of breakage of the annealed amorphous metal during this unlacing and relacing operation. Olsen's transformer cores, which would not be expected to require any annealing, would not pose any risk of breakage. Thus, Olsen does not face the same technical problems inherent to the production of a transformer core from annealed amorphous metal alloys. As Olsen is not facing the same technical problem, it is not seen how Olsen can properly be considered as suggesting a solution to the present inventors problem. As in Olsen, such problem does not even arise.

Further, with regard to Olsen, it is very clear that Olsen contemplates that his transformer cores are assembled by sliding his joints together. While this appears to be possible according to Olsen's teaching, again it is stressed that Olsen's transformer cores are produced from grain-oriented magnetic materials, most likely silicon steel. Such is generally far thicker, more flexible and thereby far less brittle than amorphous metal transformer cores which have been annealed.

A skilled artisan seeking to glean any teaching from the Olsen reference which might be useful in the manufacture of annealed amorphous metal transformer cores would most likely dismiss the Olsen reference as out of hand as Olsen's sliding together his joints would be contemplated to be highly destructive of the embrittled annealed amorphous metal. Further, as it appears that at least two joints are required in each transformer core according to Olsen, the risk of breakage at two joints in an annealed amorphous metal transformer core would also be considered highly improbable and likely quite destructive to the amorphous metal. Thereby, for all practical purposes, Olsen provides little guidance which can be considered relevant to the manufacture of annealed amorphous metal transformer cores, or to the special handling problems attendant upon annealed amorphous metals.

Turning now to U.S. Patent No. 5,063,654 to Klappert et al., Klappert provides a clever device for indexing strips of unannealed amorphous metal strips into packets. While such is a useful apparatus, nonetheless it does not address or overcome any of the inherent problems of the Olsen reference. More significantly, Klappert also does not address any further technique in the construction of amorphous metal cores beyond the cutting and stacking steps described in the four corners of that reference. As such, it cannot be seen how the Klappert reference can be fairly cited to overcome the fatal flaws of the Olsen reference. Klappert does nothing to address the technical prejudices in the art which Olsen does not face, nor suggest how that such could be overcome. Klappert should merely be understood for what it is, an improved method for stacking amorphous metal strips into groups which might ultimately be wound about a mandrel.

According, in view of the comments entered above, reconsideration of the propriety of the rejection of the claims in view of Olsen, further in view of Klappert, is respected, and withdrawal of the rejection is respectfully requested.

Regarding the rejection of claims 6 under 35 USC 103(a) in view of US 3538474 to Olsen in view of US 5063654 to Klappert, further in view of US 5134771 to Lee:

The applicants respectfully traverse the rejection of claim 6 in view of the Olsen and Klappert references, further in view of U.S. Patent No. 5,134,771 to Lee.

For sake of brevity, the undersigned hereby incorporates by reference all of the remarks entered above with regard to the Olsen and Klappert references as they are equally applicable in

rebutting the present rejection against claim 6. Turning now to the Lee reference, Lee provides only a teaching that interfacial short circuits between adjacent laminate layers in an amorphous metal transformer core, even subsequent to annealing, can be reduced by a technique described by Lee. Lee also incidentally notes that a facing material can be placed upon the edges of the transformer core and that such is ideally flexible enough when in an unhardened or uncured state to be somewhat flexible.

The applicants respectfully point out that as it is now believed that the current claims are in condition for allowance, that the independent claim as modified by any further dependent claims is also allowable for the reasons entered above.

With regard to Lee's purported teaching, at best it can be limited to a manufacturing technique as described in U.S. Patent No. 5,134,771. However, nowhere in the four corners of the Lee reference is there any mention of the types of transformer cores, transformer segments, or methods for their production which are taught only in the present application. Nothing in the Lee reference also can be seen to overcome the inherent defects in the Olsen and Klappert references. Accordingly, reconsideration and withdrawal of the rejection is respectfully requested.

Regarding the rejection of claims 15 - 18 under 35 USC 103(a) in view of US 3538474 to Olsen in view of US 5063654 to Klappert:

The applicants respectfully traverse the rejections of claims 15-18 in view of the Olsen and Klappert references.

Again, for sake of brevity, the undersigned herein incorporates all of the references made above with regard to the Olsen and Klappert references.

Again, as stated previously, very significant technical prejudices in the art attendant upon the use of annealed amorphous metal transformer cores would dissuade away from any consideration or use or method of manufacture such as the present inventors provide. Olsen's grain-oriented transformer cores do not face, nor suffer the same technical problems, which the present applicants have faced and surprisingly and successfully overcome. Additionally, the Olsen reference does not teach or suggest core segment having an "I" or "straight" type

configuration. Particularly also, Olsen does not provide or suggest any core segment having the specific step-lap configuration as described by the present inventors.

In view of the foregoing, reconsideration of the propriety of the rejection against claims 15-18 is requested, particularly in view of the amended claims.

Regarding the rejection of claim 20 under 35 USC 103(a) in view of US 3538474 to Olsen further in view of US 2465798 to Granfield:

Applicants respectfully traverse the rejection of claim 20 in view of Olsen, further in view of U.S. Patent No. 2,465,798 to Granfield.

For sake of brevity, the undersigned hereby incorporates by reference all of the references made of above with regard to the nature of annealed amorphous metals as well as to the Olsen reference discussed previously.

Turning now to the Granfield reference, again it is clear that Granfield is limited to constructions wherein grain-oriented materials, here particularly rolled silicon steel are used to make up Granfield's transformer cores.

Again, it is believed that the Granfield reference is akin to Olsen in that it too is limited to grain-oriented (silicon steel) materials. Granfield, however, is even further flawed in that his transformer cores include no laceable joints. Rather, Granfield appears to produce a transformer core from a plurality of laminated rectangular silicon steel plates which are layered in register to ultimately form the final magnetic core shape. Thus, Granfield's transformer core is not wound and thus does not require any transformer joints. Lacking such joints, Granfield does not approach the technical problem faced by the present inventors. Lacking such technical problem, it is clear that Granfield provides no suggestion how the applicants' technical problem could be overcome.

Accordingly, reconsideration and propriety of the rejection in view of the Olsen and Granfield references is solicited.

Regarding the rejection of claims 21 - 24 under 35 USC 103(a) in view of US 3538474 to Olsen in view of US 5063654 to Klappert:

The applicants respectfully traverse the rejection of claims 21-24 in view of the Olsen and Klappert references.

For sake of brevity, the undersigned herein incorporates by reference all of the remarks entered above with regard to the Olsen and Klappert references. With regard now to the rejection of claims 21-24, again, it is not believed that the specific types of annealed amorphous metal transformer cores, or methods for their production are known to the art. Such also are not obvious from the known art. Ergo, devices incorporating the types of annealed amorphous metal transformer cores as described in the independent claims could not have been known and it is therefore believed that the objection against claims 21-24 are inappropriate.

Reconsideration of the propriety of the rejection against claims, and their withdrawal, is requested.

Regarding the rejection of 25 and 26 under 35 USC 103(a) in view of US 3538474 to Olsen in view of US 5063654 to Klappert, further in view of US 4450206 to Ames:

The applicants respectfully traverse the rejection of claims 25 and 26 under Olsen in view of Klappert further in view of U.S. Patent No. 4,450,206 to Ames.

Again, for sake of brevity, the undersigned herein incorporates by reference all of the remarks entered above with regard to the Klappert and Olsen references.

Turning now to the Ames reference, it is not believed that the Ames reference provides any teaching or suggestion which would overcome the fatal flaws inherent in the Olsen and Klappert references.

Ames provides certain amorphous metal compositions which might find use in electrical and electronic devices, including transformer cores. However, nowhere in the Ames reference is there any teaching or suggestion which address and overcome the inherent material handling problems associated with annealed amorphous metals. As has been discussed above, embrittlement and cracking are serious technical problems and shortcomings which limit the wider use of annealed amorphous metals in many applications. Nothing in the Ames reference indicates that their amorphous metal compositions, subsequent to annealing, relieve this technical problem. Thereby, one of appropriate skill in the art would reasonably understand Ames to also be a brittle material when in its annealed state. Likewise, such a similarly brittle

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material would not overcome the inherent technical prejudices in the art, or suggest that the Olsen or Klappert references would be made any more relevant.

Accordingly, reconsideration of the propriety of the rejection in view of the Olsen, Klappert and Ames references and withdrawal of these references from further consideration, particularly in view of the presently amended claims is respectfully requested.

Attached is an Appendix which includes a marked-up version of the changes being made by this paper.

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Applicant asks that all claims be examined.

Please apply any charges for excess claims, as well as for the Petition for Extension of Time, calculated on the basis of the dates relevant to the Notice of Appeal to Deposit Account No. 01-1125. Should any further fees be required, or should there be any excess fees, kindly apply such charges or credits to Deposit Account No. 01-1125.

Kindly ensure that all written responses in this application be addressed to:

Honeywell Inc.
Attn: Patent Services
101 Columbia Road
Morristown, NJ 07962

Kindly ensure that telephonic inquiries be addressed to the undersigned at any of the numbers given below.

Respectfully submitted,

Date: _____

25 April 2001

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Appendix

In the claims:

Claim 2, 3, 5, 6, 8, 9, 19, 26 have been cancelled.

Claim 1, 4, 7, 14, 15, 16, 17, 18, 20, and 25 have been amended as follows:

- 1.(Four-times Amended) A transformer core comprising a plurality of individually annealed core segments each of said core segments comprising at least one packet which includes a plurality of groups of amorphous metal strips arranged in a setp-lap joint pattern.
[segments of amorphous metal strips, said strips each having ends that are in overlap and underlap contact forming an interlocking joint, each segment comprising at least one packet of said
- 4.(Amended) A transformer core according to claim 1 wherein at least one core segment [, as recited by claim 3, having a C, I, or] has a C-segment, I-segment or straight segment construction.
- 7.(Amended) A transformer core, according to [as recited by] claim 1, wherein [the] edges of each of said core segments are coated with a bonding material that protects said edges and [provides said segment with] imparts increased mechanical strength.
- 14.(Amended) A transformer core according to [as recited by] claim 1, comprising two C segments.
- 15.(Amended) A transformer core according to [as recited by] claim 14, comprising two C segments and an even number of straight segments.
- 16.(Amended) A transformer core according to [as recited by] claim 1, comprising four C segments arranged to form a shell-type core.

- 17.(Amended) A transformer core according to [as recited by] claim 1, comprising two C segments and one I segment [segments] arranged to form a shell-type core.
- 18.(Amended) A transformer core according to [as recited by] claim 1, comprising two C segments, one I segment and an even number of straight segments arranged to form a three-leg [for a three phase] transformer core.
- 20.(Amended) A transformer core according to [as recited by] claim 1, wherein at least one core segment has [said strips have varying widths arranged to provide] a cruciform shaped [shape] cross-section.
- 25.(Amended) A transformer core as recited by claim 1, wherein each of said amorphous metal strips has a composition according to [defined essentially by] the formula: $M_{70-85}Y_{5-20}Z_{0-20}$, subscripts in atom percent, where "M" is at least one of Fe, Ni and Co, "Y" is at least one of B, C and P, and "Z" is at least one of Si, Al and Ge; with the provisos that (i) up to 10 atom percent of component "M" can be replaced with at least one of the metallic species Ti, V, Cr, Mn, Cu, Zr, Nb, Mo, Ta and W, and (ii) up to 10 atom percent of components (Y + Z) can be replaced by at least one of the non-metallic species In, Sn, Sb and Pb.